STEROID INFORMATION SHEET

Athletes may use many different methods to gain a competitive advantage. One method is the use of ergogenic (performance-enhancing) drugs. Ergogenic agents include anabolic steroids, growth hormone, and erythropoietin. Stimulants may also be used as ergogenic drugs because of their ability to mask fatigue. Some athletes also use drugs that prevent the detection of ergogenic drugs in urine. Ergogenic drugs carry serious risks. Health care professionals should educate patients about the effects of these drugs and counsel patients not to use them.

Drug use by athletes has become commonplace. Many athletes use performance-enhancing drugs, known as ergogenic drugs, to improve their athletic ability beyond the levels otherwise anticipated. Examples of ergogenic drugs are anabolic steroids, growth hormone, and erythropoietin. Some athletes consider stimulants to be ergogenic because of their ability to mask fatigue. Athletes may also use drugs to aid them in circumventing drug testing.

The media have given much attention to the elite Olympic and collegiate athletes caught using drugs to aid them in competition. In addition to the unethical nature of ergogenic drug use and the possible deleterious effects of these agents, many ergogenic drugs are banned for use by athletes competing in events sanctioned by the International Olympic Committee (IOC) and the National Collegiate Athletic Association (NCAA). One researcher surveyed over 2,200 collegiate athletes at 11 different institutions for anabolic steroid use. The incidence was 6% among male athletes and 1% among female athletes. Athletes in the following sports reported the highest use: football (10%), track and field (4%), basketball (2%), baseball (2%), and tennis (2%). Among international Olympic competitors, positive test results for any drug banned by the IOC decreased from 1,153 (2.45%) in 1988 to 993 (1.13%) in 1992. During the 1992 Olympic Games, the banned drugs most frequently used were anabolic steroids (57.3%), stimulants (22.1%), narcotics (8.1%), diuretics (5.6%), masking agents (1.8%), and beta-blockers (0.96%).

Drug use by athletes is not limited to Olympic or college sports. High school and junior high school athletes are using anabolic steroids at a reported incidence of 1.4% to 10.9%. One researcher found that of over 800 junior high school students, 3.8% reported using anabolic steroids. More alarming are the reasons for their use: to increase muscle strength and size, to prevent and treat sports injuries, to improve sexual performance, to increase sexual organ size, and to improve physical performance. It was also noted that these students lack medical knowledge about the side effects of steroids. The reported incidence of female junior and senior high school students using anabolic steroids is 0.5% to 6.7%. This dangerous trend has significance for health care professionals who must be aware of symptoms of ergogenic drug use and educate individuals about the risks of using these drugs.

Ergogenic Drugs

The following discussion focuses on anabolic steroids, growth hormone, erythropoietin, and stimulants. Table 1 lists these and other commonly used drugs and specifies their possible ergogenic effects.

Table 1--Possible Side Effects of Ergogenic Drugs

beta-Agonists (eg, clenbuterol*): increase muscle mass, strength
Erythropoietin: increases endurance
Growth hormone: increases muscle mass, strength†
Stimulants

- Amphetamines: increase strength, alertness, endurance
- Caffeine: reduces fatigue
- Ephedrine: increases alertness
- Phenylpropanolamine: increases alertness
- Pseudoephedrine: increases alertness

Synthetic testosterone derivatives (eg, anabolic steroids): increase muscle mass, strength
* Not available in the United States.
†Drugs that stimulate endogenous growth hormone are amino acids, beta-blockers, bromocriptine, clonidine, gonadotropin-releasing hormones, levodopa, and vasopressin.

Anabolic Steroids

Anabolic steroids are synthetic derivatives of the male sex hormone testosterone. Some athletes use anabolic steroids to increase lean body mass and strength and to reduce recovery time between workouts. However, controlled studies of the effect of these drugs on muscle strength are difficult to conduct. Some athletes use megadoses of these drugs, sometimes 100 times the normal dose; it is unethical to administer such doses to healthy persons in clinical trials. Additionally, the severity of side effects occurring at these doses precludes a truly blinded study. Most data are based on anecdotal evidence, and the results are difficult to interpret.

A review of the literature reveals that these agents may slightly enhance muscle strength in previously trained athletes. However, unless anabolic steroids are combined with a high-calorie, high-protein diet and intense weight training, muscle size does not increase.

Anabolic steroids promote tissue growth by stimulating protein synthesis and retarding protein catabolism. They promote messenger RNA synthesis, thereby stimulating synthesis of protein in muscle cells. Besides anabolic, or tissue-building, properties, these agents also have androgenic, or masculinizing, properties. A purely anabolic steroid has not been isolated. Determination of anabolic or androgenic response depends on the location of the cell type, not the nature of the steroid.

During periods of stress and intense training, levels of endogenous cortisol increase significantly, resulting in a negative nitrogen balance and muscle wasting. Anabolic steroids reverse these catabolic effects by displacing cortisol from its receptors, allowing the athlete to continue training at a high level. The athlete needs to maintain a high-protein, high-calorie diet before and during anabolic steroid use, in response to the body's increased ability to synthesize protein and prevent protein breakdown.

Athletes use various techniques for taking anabolic steroids. They often take multiple steroids (both oral and injectable forms), a process dubbed "stacking." Taking the drug in cycles of 6 to 12 weeks, followed by drug-free periods of 6 weeks to several months, a method known as "cycling," allows desaturation of the anabolic steroid receptor and enhances the drug's effectiveness. Dosage is initially low, then raised to a peak and subsequently tapered, a process called "pyramiding."

Most of the information on the adverse effects of anabolic steroids is obtained from patients receiving these drugs for legitimate medical reasons: certain anemias, hereditary angioedema, and certain cases of breast cancer.[7] In these patients, anabolic steroids are found to produce a wide array of adverse effects, which may differ from those in the athletes who use extremely large doses. Table 2 lists the side effects of anabolic steroids. Some male athletes administer other drugs to combat the deleterious effects of anabolic steroids. Gonadotropin-releasing hormones (GnRH), human chorionic gonadotropin (hCG), and menotropins are administered to stimulate the production of endogenous testosterone and maintain testicular function.

Table 2--Side Effects of Anabolic Steroids*

Endocrine and Reproductive

Male

- Decreased levels of reproductive hormones
- Testicular atrophy
- Oligospermia and azoospermia
- Gynecomastia
- Prostatic hypertrophy
- Prostatic carcinoma
- Priapism
- Altered glucose metabolism (insulin resistance, glucose intolerance)
- Altered thyroid profile (decreased T3, T4, TSH, and TBG)

Female

- Masculinization
- Hirsutism
- Deepening of the voice
- Clitoral hypertrophy
- Menstrual irregularities
- Male pattern alopecia

Altered glucose metabolism (insulin resistance, glucose intolerance)
Altered thyroid profile (decreased T3, T4, TSH, and TBG)

Cardiovascular and Hematologic

Decreased HDL cholesterol
Increased LDL cholesterol
Hypertension (sodium and water retention)
Clotting abnormalities
Myocardial infarction
Left ventricular hypertrophy
Cerebrovascular accident

Renal

Elevated BUN, creatine
Wilms' tumor

Dermatologic

Acne
Alopecia
Temporal hair recession
Skin rash

Hepatic

Elevated liver function test results
Cholestatic jaundice
Hepatocellular carcinoma (> 24 mo use)
Peliosis hepatis (> 6 mo use)
Hepatoma
Hepatitis

Musculoskeletal

Increased risk of musculotendinous injury
Avascular necrosis of femoral heads
Premature epiphyseal closure (adolescents)

Subjective

Edema
Muscle spasm
Anxiety
Increased urine output
Headaches
Dizziness
Nausea
Euphoria
Urethritis
Scrotal pain
Irritability
Suicide ideation or attempts

Psychological

Aggressive behavior
Mood swings
Increased or decreased libido
Dependency
Acute psychosis
Manic and/or depressive episodes

Miscellaneous

AIDS transmission as a result of needle sharing

*Classified as schedule 3 controlled substances.
BUN = blood urea nitrogen; HDL = high-density lipoprotein; LDL = low-density lipoprotein; T3 = triiodothyronine; T4 = thyroxine;TBG = thyroxine-binding globulin; TSH = thyroid-stimulating hormone.
From Graphery,[17] with permission.